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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

HM-394PCT

Applicant(s)	:	August Sprock
Serial No.	:	09/744,485
Int. Filed	:	JULY 17, 1999
For	:	METHOD AND INSTALLATION FOR PRODUCING DUAL-PHASE STEEL

Assistant Commissioner for Patents
Washington, D.C. 20231

RESPONSE TO NOTIFICATION OF MISSING REQUIREMENTS

Sir:

In response to the Notification of Missing Requirements dated **March 2, 2001** applicant submits herewith a duly executed declaration.

The fee of $130.00 is being charged as per attached form PTO-2038.

A Translation of Amended Pages 2, 2a and Claims 1-4 of WO 00/05422 is also enclosed.

Should any additional fee be required, the Commissioner is authorized to charge such fee, or credit any overpayment, to Deposit Account No. 11-1835

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As required, a copy of the Notification of Missing Requirements is attached.

Since all the missing requirements have now been supplied, it is submitted that the application is now complete and in form for examination. Accordingly, such examination and prompt allowance are earnestly solicited.

Respectfully submitted,

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Encls:
Copy of Notification of Missing Requirements;
Executed Declaration;
Amended Pages;
FORM PTO-2038 ($130.00).

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on March 7, 2001.

March 7, 2001

Friedrich Kueffner

Translation of Amended Pages 2, 2a and Claims 1-4 of WO 00/05422 (PCT/EP99/05113)

of a dual-phase microstructure depends in this connection significantly on the cooling speeds made possible by the device technology and on the steel composition. Important for the manufacture of dual-phase steels is a sufficient ferrite formation in the first cooling stage.

With respect to device technology, a sufficient ferrite formation is achieved, for example, by cooling with water to a temperature of approximately 620 - 650 °C with subsequent air cooling. The duration of air cooling (approximately 8 seconds) is selected such that at least 70 % of the austenite is transformed into ferrite before the second cooling stage begins. A transformation into the pearlite stage should be avoided during the first cooling stage as well as during air cooling.

In the second cooling stage there must still be so much cooling capacity present that hasp temperatures below the martensite starting temperature are achieved. Only then the formation of a dual-phase microstructure with ferrite and martensite components is ensured. This known manufacture presents no problem for small strip speeds because sufficient cooling capacities for the martensite transformation are available at the end of the first cooling stage.

For very high strip speeds, however, the beginning of the second cooling stage can be displaced within the current cooling stretch to such an extent that the subsequent martensite formation occurs

only incompletely or not at all because then the cooling capacity for adjustment of the required low-temperature (< 220° C) is no longer sufficient. A mixed microstructure of ferrite, bainite and proportions of martensite will result that cannot fulfill the desired mechanical properties of a pure dual-phase microstructure.

From EP-A-0 747 495 a method for manufacture of hot-rolled steel sheet is known whose structure comprises at least 75 % ferrite and at least 10 % martensite. For its manufacture, the steel is cooled in a targeted fashion after hot-rolling, in particular, in a first cooling stage with a cooling rate of 2 to 15°C/s within a time period of 8 to 40 seconds to a temperature between Ar_1 point and 730°C and thereafter in a second cooling stage with a cooling rate of 20 to 150° per second to a temperature of 300°C. As an alternative, a quick cooling with a cooling rate of 20 to 150°C/s is used before the first cooling stage that leads to a temperature below the Ar_3 point.

From the printed publication Patent Abstracts of Japan vol. 006, No. 191(C-127), 30 September 1982, and JP 57 104650 A (Kobe Steel Ltd.), 29 June 1982, a method for manufacturing a hot-rolled steel sheet comprised of ferrite and a proportion of 1 to 30 % martensite is known which is also generated by a two-stage cooling. According to this method, cooling is carried out slowly to a temperature between the Ar_1 point and 550°C at a cooling rate of 5 to 30°C/second and, subsequently, cooling is carried out with a fast cooling rate of > 30°C/s to a temperature in the range of 350 to 500°C in a second cooling stage.

Based on this known prior art, it is an object of the invention to provide a method and a device for producing dual-phase

Claims

1. Method for producing dual-phase steels from the hot-rolled state with a two-phase microstructure of 70 to 90 % ferrite and 30 to 10 % martensite by a controlled temperature guiding and defined cooling strategy during the cooling of the steels, inter alia by means of water cooling after their finish rolling, wherein in a first cooling stage at a cooling rate of < 30 K/s the cooling curve enters the ferrite region and, after reaching the required ferrite contents, further cooling is carried out in a second cooling stage at a cooling rate of > 30 K/s to temperatures below the martensite starting temperature, characterized in that

   a) the first cooling stage (14) is carried out in a cooling stretch of water cooling stages (7), arranged successively at a spacing, or in a cooling system with continuously changeable cooling medium quantity with a cooling rate of 30 K/s adjusted such

   b) that the cooling curve (10) enters the ferrite region a temperature still so high that the ferrite formation can take place quickly; and,

   c) before begin of the second cooling stage (16), which follows without intermediate air cooling and holding time directly after the first cooling stage (14), already at least 70 % of the austenite is transformed to ferrite.

2. Method according to claim 1, characterized in that the cooling of the first cooling stage is continued during the transformation of the austenite into ferrite up to the desired ferrite contents of at least 70 %.

3. Device for performing the method according to one or several of the preceding claims, for producing dual-phase steels from the hot-rolled state, characterized by a cooling stretch (6) arranged behind the last finish roll stand (1) and having several water cooling stages (7) positioned successively at a spacing or having cooling systems with a continuously adjustable cooling medium quantity.

4. Device according to claim 3, characterized in that the number of water cooling stages (7), their effective length, and their spacing from one another are changeable or continuously adjustable in the case of quantity control.